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TITLE: Altitude Symptomatology and Mood States during a Climb to 3630 M

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RUNNING HEAD: Symptoms and Moods during a Climb

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## ABSTRACT

Ascents to altitudes above 3050 m have been shown to cause adverse changes in symptoms and moods. It is thought that the severity of these changes not only depends on the altitude and rate of climb, but also on the length of stay and the effort expended to reach the desired altitude. In order to better understand how these factors influence symptom and mood changes during a climb, this study systematically assessed symptoms and moods during an ascent to 3630 m.

Self-rated symptoms and moods were determined in seven male volunteers over a period of seven days during a climb to 3630 m of Mount Sanford, Alaska. The subjects were tested five times - twice at 2225 m, then at 2530, 3080, and 3630 m. Symptoms and moods were assessed with the Environmental Symptoms Questionnaire (ESQ) and the Profile of Mood States (POMS), respectively.

Seven symptom factors and two mood factors were found to be adversely affected over time by the changes in altitude. More specifically, the subjects experienced more respiratory acute mountain sickness (AMS), exertion stress, and muscular discomfort and they were also colder, less alert, less vigorous, and more fatigued at higher elevations. These changes occurred primarily at 3630 m and most also occurred at 3080 m. The changes were always different from the values on the second day at 2225 m and they sometimes differed from the values on the first day at 2225 or 2530 m. Therefore, this study demonstrated that a climb to 3630 m produces adverse changes in symptomatology and mood states and that factors other than just level of altitude can affect these parameters.

Index terms: Environmental Symptoms Questionnaire (ESQ), Profile of Mood States (POMS), Acute Mountain Sickness (AMS)

High altitude environments can be challenging and debilitating to climbers both because of the level of the altitude and the terrain. Altitudes above 3050 m have been shown to cause symptoms of acute mountain sickness (AMS) (2,3,5) as well as adverse changes in mood states (1,6,9,14). The number, severity, rapidity of onset, and duration of AMS symptoms and adverse mood changes vary from person to person and are related to both level of altitude and rate of ascent (4,14). Generally, AMS symptoms and mood changes are most severe during the first or second day at altitude and then gradually recede over the next 2 - 4 days (2,4,14,16).

AMS is a disorder that is characterized by symptoms such as headache, dizziness, loss of appetite, nausea, fatigue, insomnia, irritability, depression, and difficulty with thinking (2,5). Symptom occurrence and severity have been assessed in past studies with the Environmental Symptoms Questionnaire (ESQ) (7,12,13,18). In one study, the questionnaire scores for headache, nausea, and the general feeling of ill health correlated well with AMS scores obtained by clinical interview (18).

Changes in mood at altitude are not as well documented as AMS symptomatology. Observed behaviors and personal anecdotes suggest that initial euphoria is followed by depression. With time, individuals may also become quarrelsome, irritable, and apathetic (15). The Clyde Mood Scale has been used in previous studies to assess mood changes at altitude (1,14). In these studies, subjects reported that they became less friendly, clear thinking, and unhappy and more sleepy and dizzy at an altitude of 4300 m. Another study using the Profile of Mood States (POMS) showed that two mood factors, vigor and fatigue, varied systematically with simulated altitude; subjective reports of vigor decreased and subjective reports of fatigue

increased with increased simulated altitude (6).

Not only do the altitude and rate of climb affect AMS symptomatology and mood states but also the length of stay and the effort expended determine whether an individual will or will not have some kind of altitude illness. AMS symptoms will be less severe if more time is taken to reach the designated altitude. If the climb is to be above 3050 m, 305 m a day is usually a safe distance to climb, but this number will vary from person to person (5).

Few studies have systematically measured symptom and mood changes during a climb. One investigation used a modified ESQ during a high altitude research expedition involving a rapid ascent to 4980 m (18). A high correlation was found between appropriate ESQ questions and the AMS score assessed by clinical interview. In another study, subjects ascended from sea-level to 3600 m by a combination of road, rail, and foot in 36 h (17). One administration of the ESQ given 12 h after ascent showed that all subjects experienced symptoms of benign AMS. The prominent symptoms were headache, difficult or fast breathing, light-headedness, and weakness. A different symptom questionnaire was given in another study where 45 subjects climbed to 3353 m and 31 continued to 4392 m (the summit of Mount Rainier) (11). The subjects experienced headaches, nausea, shortness of breath, dizziness, or pounding heart throughout the ascent to high altitude. Also, symptom scores for active, energetic, refreshed, and vigorous declined at 4000 m. Another study tested changes in eight women participating in an expedition to 6248 m (10). It was found that the physiologically based symptoms of altitude, as measured by the ESQ, began at 3658 m and were most pronounced at 4511 m. The relative lack of symptoms above this altitude was attributed to the slower ascent and forced acclimatization because of illness at 4511 m (10). Still another study found sharp increases in paranoia and obsessive-compulsiveness and smaller increases in depression, hostility, and anxiety at an altitude of 5000 m during a 35 d climb of Denali (9).

The purpose of the present study was to assess symptoms and moods during a climb of Mount Sanford to 3630 m. Symptomatology and mood states were evaluated with the ESQ and the POMS. These questionnaires were administered over a seven day period at different altitudes. This examination of periodic symptom and mood assessment should contribute to our understanding of symptomatology and mood changes associated with a climb to high altitude.

## MATERIALS AND METHODS

Subjects: Seven male volunteers from the US Army served as subjects. They participated in this study as part of a training climb in preparation for a Mount McKinley climb later in the year. Other soldiers participated in the climb but only these seven volunteers had complete data to analyze.

Assessment instruments: The Environmental Symptoms Questionnaire (ESQ) was used to assess the presence and severity of AMS symptoms. The ESQ is a 67 item instrument and it was administered in card format. The 67 items are rated on a six-point scale and cluster into nine factor scores: cerebral AMS, respiratory AMS, ear/nose/throat, cold, distress, alertness, exertion, muscular discomfort, and fatigue (12,13). The Profile of Mood States (POMS) was used to assess the subjects' moods. It consists of 65 adjectives rated on a five-point scale and it was also administered in card format. Prior statistical analysis has shown that the 65 adjectives cluster into six principal mood factors: tension, depression, anger, vigor, fatigue, and confusion (8).

Procedures: The climb to 3630 m of Mount Sanford took place over a period of seven days in mid-March. Mount Sanford achieves an altitude of 4949 m and it is located in the Wrangell Mountains of Alaska. The ambient temperature during the climb ranged from -23 to -13 C. Strong winds generally prevailed,

however wind speed was not measured.

The two questionnaires were initially administered on the first day of the expedition at an altitude of 2225 m. They were administered at noon, right after setting up camp. The second administration took place before breakfast the next day at the same altitude (2225 m). The questionnaires were then given the next day at 2530 m, two days later at 3080 m, and two days after that at 3630 m. These three administrations were all given in the morning before breakfast.

Values for each symptom and mood factor were calculated for each day at 2225, 2225, 2530, 3080, and 3630 m. Separate one-way repeated measures analyses of variance were used to determine whether there were overall differences between the means. Then, post hoc comparisons were performed with the Tukey test to identify which values were different from each other. A significance level of  $p \leq .05$  was chosen for all statistical tests.

## RESULTS

Mean symptom scores for seven ESQ factors for the various altitudes are shown in Figure 1. These seven of the nine factors showed significant differences over time between the means: cerebral AMS, respiratory AMS, cold, alert, exertion, muscular discomfort, and fatigue. The post hoc comparisons revealed which means were significantly different from each other. At 3630 m, subjects experienced more respiratory AMS than at either the second day at 2225 m or at 2530 m. Also at 3630 m, subjects were colder than they were on the second day at 2225 m. At both 3080 and 3630 m the soldiers were not as alert and they were more fatigued than they were on day two at 2225 m. They experienced more exertion stress at 3080 m than on the second day at 2225 and more at 3630 m than on the second day at 2225 m or at 2530 m. Subjects had



less muscular discomfort on both days at 2225 m than at either 3080 or 3630 m. Cerebral AMS showed no post hoc differences.

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Figure 1 about here  
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Mean mood scores for two POMS factors for the different altitudes are shown in Figure 2. Of the six POMS factors only vigor and fatigue showed significant differences over time between the means. Subjects reported that they were less vigorous at 3080 m than either day at 2225 m and they were also less vigorous at 3630 m than on day two at 2225 m. At 3080 m, they were more fatigued than they were either day at 2225 m. None of the other mood factors showed any significant differences over time.

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Figure 2 about here  
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Thus, seven symptom factors and two mood factors were found to be adversely affected over time by the changes in altitude. The subjects experienced more respiratory AMS, exertion stress, and muscular discomfort at higher altitudes. They were also colder, less alert and vigorous, as well as more fatigued at higher elevations. All of the adverse changes, except one, occurred at 3630 m and most also occurred at 3080 m. The factor scores at these altitudes always differed from the values on the second day at 2225 m. In addition, they sometimes differed from the values on the first day at 2225 m or from the values at 2530 m.

## DISCUSSION

These data showed that most symptoms and some moods were adversely affected by the climb to 3630 m. These data are in agreement with the few other studies which measured symptom and mood changes at altitude (9,10,11,17,18). All of the changes in this study occurred at altitudes of 3080 m or greater, supporting previous research which reports that altitudes above 3050 m cause symptoms of AMS and adverse changes in mood states (1,2,3,5,6,9,14). Also, the subjects reported less, although not significantly less, symptomatology and fewer adverse mood changes on the second day at 2225 m, showing that some degree of acclimatization had taken place from day 1 to day 2 at this altitude. This result supports the research that reports symptoms will be less severe if more time is taken to reach the designated altitude (5).

Adverse changes occurred above 3050 m even though the soldiers climbed, on the average, less than 305 m a day after the first day. However, it is interesting that most of the symptoms and moods that did change were factors which are usually associated with exercise, not necessarily AMS. Cerebral AMS was not one of the symptoms affected by the climb. On the other hand, the climbers were less vigorous, more fatigued, less alert, while they perceived more muscular discomfort and exertion. They also experienced more respiratory AMS and the leading items for this factor are "hard to breathe", "short of breath", and "hurts to breathe". These are all symptoms which could be associated with vigorous exercise. The soldiers were also colder at 3630 m and this result is not surprising since it is colder and windier on mountains; the temperature falls <sup>0</sup> 1 C for every 150 m of ascent (16).

This study demonstrated that a climb to 3630 m produces adverse changes in symptomatology and mood states. Some factors that influence how severe these changes are include the level of altitude, the rate of climb, the

terrain, and the environment on the mountain. Therefore, even if more time is taken to reach the desired altitude, other factors such as the effort expended or the temperature can influence whether or not an individual will or will not have some kind of altitude illness or other symptomatology. It is important to keep these factors in mind when attempting to generalize from chamber studies to what may actually happen on the mountain.

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1. The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation.

2. Human subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Regulation 70-25 on Use of Volunteers in Research.

## FIGURE CAPTIONS

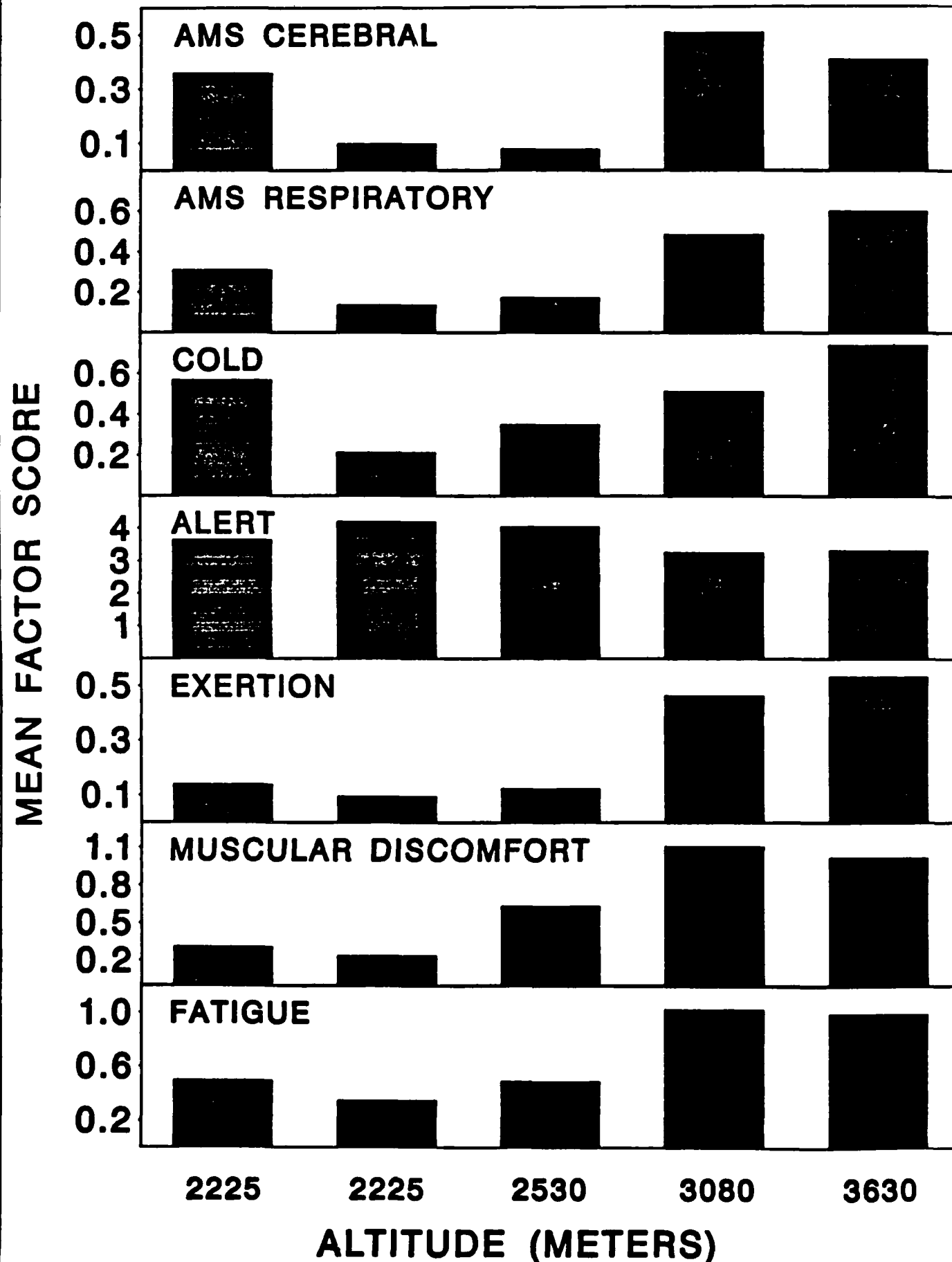
Figure 1. Environmental Symptoms Questionnaire factor scores for AMS cerebral, AMS respiratory, cold, alert, exertion, muscular discomfort, and fatigue at 2225, 2225, 2530, 3080, and 3630 m.

Figure 2. Profile of Mood States factor scores for vigor and fatigue at 2225, 2225, 2530, 3080, and 3630 m.



# SYMPTOMS AT VARIOUS ALTITUDES

## ENVIRONMENTAL SYMPTOMS QUESTIONNAIRE



# MOODS AT VARIOUS ALTITUDES

## PROFILE OF MOOD STATES

